WHAT IS CLAIMED IS:

1. A method of controlling contraction of a heart to improve hemodynamic performance, comprising:

receiving electrical signals from at least a portion of the heart;

determining a progress of contraction in the heart based on the received signals; and

stimulating a chamber of the heart at a plurality of locations in the chamber based on the progress of contraction.

2. The method of claim 1, wherein receiving electrical signals comprises sensing depolarization signals originating from at least one atrium of the heart.

3. The method of claim 2, wherein sensing depolarization signals comprises sensing depolarization signals from multiple locations within an atrial chamber.

4. The method of claim 1, wherein receiving electrical signals comprises sensing depolarization signals originating from at least one ventricle of the heart.

5. The method of claim 4, wherein sensing depolarization signals comprises sensing depolarization signals from multiple locations within a ventricular chamber.

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

6. The method of claim 1, wherein determining the progress of contraction of the heart comprises:

analyzing electrical activity from a first location in the chamber;

analyzing electrical activity from at least one additional location in the chamber; and

determining a delay between the electrical activity sensed from the first location and the at least one additional location.

7. The method of claim 1, wherein stimulating the chamber of the heart at the plurality of locations in the chamber based on the progress of contraction comprises:

applying a first electrical signal to stimulate contraction at a first location in the chamber; and

selectively applying a second electrical signal to stimulate contraction at a second location in the chamber.

8. The method of claim 7, wherein selectively applying the second electrical signal to stimulate contraction at the second location in the chamber comprises:

receiving signals indicating electrical activity at the second location in the chamber; and

applying the second electrical signal when the electrical activity at the second location fails to reach a threshold level within an interval of time.

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

9. The method of claim 7, wherein applying the second electrical signal comprises applying the second electrical signal simultaneously with applying the first electrical signal.

10. The method of claim 1, wherein stimulating the chamber of the heart at the plurality of locations in the chamber comprises stimulating at least two locations in the chamber of the heart along a short axis of the chamber.

11. The method of claim 1, wherein stimulating the chamber of the heart at the plurality of locations in the chamber comprises stimulating at least two locations in the chamber of the heart along a long axis of the chamber.

12. The method of claim 1, wherein stimulating the chamber of the heart at the plurality of locations in the chamber comprises stimulating at least three locations in the chamber of the heart.

13. The method of claim 1, further comprising:

applying a pre-excitation voltage to at least one portion of the heart before the at least one portion of the heart contracts in order to precondition the at least one portion of the heart.

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

14. The method of claim 13, wherein applying a pre-excitation voltage comprises either applying an anodal voltage to enhance the speed of conduction in the at least one portion of the heart or applying a cathodal voltage to inhibit the speed of conduction in the at least one portion of the heart.

15. The method of claim 13, wherein the pre-excitation voltage is applied to an electrode implanted in the interventricular septum.

16. The method of claim 15, wherein stimulating a chamber of the heart comprises delivering a current of approximately 10 milliamps.

17. The method of claim 1, wherein stimulating the chamber of the heart at a plurality of locations in the chamber based on the progress of contraction comprises:

applying a pre-excitation voltage to pre-excite a first location in the chamber; and

applying a second electrical signal to stimulate contraction at a second location in the chamber when the electrical activity at the second location fails to reach a threshold level within an interval of time.

18. An apparatus for controlling contraction of a heart to improve hemodynamic performance, comprising:

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

means for receiving signals indicating electrical activity of sinus rhythm from at least a portion of the heart;

means for determining a progress of contraction of the heart based on the received signals; and

means for stimulating a chamber of the heart at a plurality of locations in the chamber based on the progress of contraction.

19. A system for controlling contraction of a heart to improve hemodynamic performance, comprising:

at least one sensing element configured to receive electrical signals from the heart;

a processor coupled to the at least one sensing element, configured to determine a progress of contraction of the heart based on the received signals, and configured to provide one or more control signals based on a timing of the received signals; and

a signal generator, coupled to the processor, to provide at least one electrical signal for selectively stimulating contraction at a plurality of locations in the chamber in response to the one or more control signals.

20. The system of claim 19, wherein the at least one sensing element comprises a plurality of electrodes configured to be installed endocardially in the heart.

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

21. The system of claim 19, wherein the signal generator varies the voltage level in the electrical signal based on the one or more control signals.

22. The system of claim 19, wherein the signal generator varies a pulse width of the at least one pulse in the electrical signal based on the one or more control signals.

23. The system of claim 19, further comprising a plurality of electrodes, wherein at least two of the plurality of electrodes are implanted in a single chamber of the heart.

24. A method of stimulating of a heart to improve hemodynamic performance, comprising:

stimulating the left ventricle of the heart at a plurality of locations in the left ventricle.

25. The method of claim 24, further comprising:

receiving electrical signals from at least a portion of the heart; and

stimulating the left ventricle at a plurality of locations based on the timing of the received electrical signals.

26. The method of claim 25, further comprising:

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

determining a progress of contraction in the heart based on the received signals; and

stimulating the left ventricle of the heart at a plurality of locations ventricle based on the progress of contraction.

27. The method of claim 25, wherein receiving electrical signals comprises receiving electrical signals from electrodes implanted in at least one of the interventricular septum, a coronary vein in the left ventricle, and the epicardial wall of the left ventricle.

28. The method of claim 25, wherein receiving electrical signals includes receiving electrical signals from an electrode connected to a lead passing through the superior vena cava, the right atrium, the ostium of the coronary sinus, and a coronary vein of the left ventricle.

29. The method of claim 26, wherein determining the progress of contraction in the heart comprises:

analyzing electrical activity from a first location in the left ventricle;

analyzing electrical activity from at second location in the left ventricle; and

determining a delay between the electrical activity sensed from the first location and the second location in the left ventricle.

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

30. The method of claim 26, wherein stimulating the left ventricle at the plurality of locations in the left ventricle based on the progress of contraction comprises:

applying a first electrical signal to stimulate contraction at a first location in the left ventricle; and

selectively applying a second electrical signal to stimulate contraction at a second location in the left ventricle.

31. The method of claim 30, wherein selectively applying the second electrical signal to stimulate contraction at the second location in the left ventricle comprises:

receiving signals indicating electrical activity at the second location in the left ventricle; and

applying the second electrical signal when the electrical activity at the second location fails to reach a threshold level within an interval of time.

32. The method of claim 30, wherein applying the second electrical signal comprises applying the second electrical signal simultaneously with applying the first electrical signal.

33. The method of claim 25, wherein stimulating the left ventricle of the heart at the plurality of locations in the left ventricle includes stimulating electrodes

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

implanted in at least one of the interventricular septum, a coronary vein of the left ventricle, and the epicardial wall of the left ventricle.

34. The method of claim 25, wherein stimulating the left ventricle of the heart at the plurality of locations in the left ventricle comprises stimulating at a first electrode in the interventricular septum and at a second electrode in a coronary vein of the left ventricle.

35. The method of claim 25, wherein stimulating the left ventricle of the heart at the plurality of locations in the left ventricle comprises stimulating at least three locations in the left ventricle.

36. The method of claim 25, further comprising:

applying a pre-excitation voltage to the interventricular septum shortly before the contraction of the right ventricle.

37. The method of claim 36, wherein applying a pre-excitation voltage comprises either applying an anodal voltage to enhance the speed of conduction in the vicinity of the interventricular septum applying a cathodal voltage to inhibit the speed of conduction in the vicinity of the interventricular septum.

38. The method of claim 24, wherein stimulating the left ventricle at a plurality of locations comprises:

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

stimulating a first electrode implanted in the interventricular septum; and

stimulating a second electrode implanted in a coronary vein in the left ventricle after an interval of time.

39. The method of claim 24, wherein stimulating the left ventricle at a plurality of locations comprises:

stimulating a first electrode implanted in the interventricular septum; and

simultaneously stimulating a second electrode implanted in a coronary vein the left ventricle.

40. The method of claim 24, wherein stimulating the left ventricle at a plurality of locations comprises delivering a current pulse of approximately 10 milliamps to at least one electrode.

41. A system for controlling contraction of a heart, comprising:

at least one sensing element configured to receive electrical signals from at least a portion of the heart;

a processor coupled to the at least one sensing element, configured to provide one or more control signals based on a timing of the received signals; and

LAW OFFICES
FINNEGAN, HENDERSON, FARABOW, GARRETT, & DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

a signal generator, coupled to the processor, to provide at least one electrical signal for selectively stimulating contraction at a plurality of locations in the left ventricle in response to the one or more control signals.

42. The system of claim 41, wherein the processor is further configured to determine a progress of contraction in the left ventricle of the heart based on the received signals.

43. The system of claim 41, wherein the at least one sensing element comprises a plurality of electrodes configured to be installed in at least one of the interventricular septum, a coronary vein in the left ventricle, and an epicardial wall of the left ventricle.

44. The system of claim 41, wherein the signal generator varies the voltage level in the electrical signal based on the one or more control signals.

45. The system of claim 41, further comprising:

a first electrode implanted in the interventricular septum; and

a second electrode implanted in a coronary vein of the left ventricle, wherein the signal generator provides electrical signals to the first and second electrodes for selectively stimulating contraction of the left ventricle.

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

46. A method of stimulating of a heart to improve hemodynamic performance, comprising:

applying a first electrical signal to a first electrode implanted in the interventricular septum; and

selectively applying a second electrical signal to a second electrode implanted in a coronary vein of the left ventricle.

47. The method of claim 46, wherein selectively applying a second electrical signal to a second electrode comprises:

receiving signals indicating electrical activity in the vicinity of the second electrode; and

applying the second electrical signal when the electrical activity at the second location fails to reach a threshold level within an interval of time.

48. A method of stimulating of a heart to improve hemodynamic performance, comprising:

sensing the initiation of a contraction of the heart;

applying a pre-excitation voltage to at least a first electrode implanted in the interventricular septum; and

selectively applying a voltage sufficient to stimulate contraction to at least a second electrode implanted in the left ventricle.

LAW OFFICES
FINNEGAN, HENDERSON,
FARABOW, GARRETT,
& DUNNER, L.L.P.
1300 I STREET, N. W.
WASHINGTON, DC 20005
202-408-4000

49. The method of claim 48, wherein selectively applying a voltage sufficient to stimulate contract to at least a second electrode implanted in the left ventricle comprises:

receiving an electrical signal from the vicinity of the second electrode; and

applying a voltage sufficient to stimulate contraction to the second electrode when the signal fails to reach a threshold within an interval of time.

50. The method of claim 48, wherein selectively applying a voltage sufficient to stimulate contraction to at least a second electrode implanted in the left ventricle comprises:

applying a voltage sufficient to stimulate contraction to the second electrode after an interval of time.

51. A method of controlling contraction of a heart to improve hemodynamic performance, comprising:

applying a first electrical signal to a first electrode implanted in the interventricular septum of the heart; and

applying a second electrical signal to a second electrode implanted in the left ventricle.

52. The method of claim 51, wherein the second electrode is implanted in one of the coronary sinus, a coronary vein the left ventricle, the interventricular septum, or in an epicardial wall of the left ventricle.

53. The method of claim 51, wherein applying a second electrical signal comprises:

receiving a third electrical signal from the vicinity of the second electrode;

applying the second electrical signal when the third electrical signal fails to reach a threshold level within an interval of time.

54. The method of claim 51, wherein the first electrical signal is a pre-excitation voltage.